International Council for
the Exploration of the Sea

C.M. 1986/F:20
Mariculture Committee

GROWTH OF JUVENILE HALIBUT (HIPPOGLOSSUS HIPPOGLOSSUS L.) IN CAPTIVITY

by

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ABSTRACT

The growth and substrate preference of collected wild juvenile halibut under culture conditions were investigated. The size of the collected fish conformed well with year class data from earlier studies.

Halibut growth in nature is slower than for i.e. cultured salmon up to the III-group. The present study showed, however, that halibut can grow much faster in culture than what is normal in nature.

The substrate studies were contradictory in terms of growth and will have to be extended. The fish without substrate did, however, develope a dark coloration on the underside.

INTRODUCTION

Halibut has traditionally been one of the best paid products in the fisheries of the arctic and boreal regions of the northern hemisphere. With the growing activity in the field of aquaculture halibut is therefore one of the most interesting marine species presently being considered for cultivation.

Methods for fry production are now being developed (Rabben et al., 1986, Berg and Øiestad, 1986) and commercial production of halibut is going to be started in Norway in 1987.

The present paper deals with the growth of juvenile halibut in captivity and in the nature.

MATERIAL AND METHODS

The fish used in the experiments were caught with Danish seine in costal waters off Møre in 1985. After collection storage in a 6 m cylindrical tank with 3 m diameter the fish were transported to Austevoll Marine Aquaculture Station in two shipments. During transport the fish were held in oxygenated tanks. The first shipment contained 26 halibut and arrived 25th of June. The second shipment of 56 halibut arrived 3rd of December.

The fish of the first shipment were held together with the halibut brood stock at the Station until the next shipment arrived. At that time only 16 of the first shipment remained. The smallest fish had either been eaten by the big halibut or escaped throught the overflow strainer.

All fish were individually tagged on arrival. Both groups were now mixed and the whole population was split on three tanks according to weight. Fish bigger than 2 kg (the remaining fish of the first shipment plus four from the second) were put in a square 3

by 3 m tank with a water depth of 60 cm and a roof of PVC coated nylon. The 52 remaining fish were put in two cylindrical tanks with a diameter of 1,5 m, a water depth of 80 cm, and roofs of black polyethylene netting. The 12 fish between 2 kg and 800 g were placed in one tank while the 40 fish smaller than 800 g were placed in the other. Sand was used as a botton substrate in all 3 tanks. All tanks were supplied with ambient water from 55 m depth.

At weighing on February 18th 1986 the total number of fish was reduced to 63, mainly due to mortality from unhealing wounds developed during catching and transport.

At the weighing of April 15th the remaining 42 fish in the cylindrical tanks were mixed, weighed and put back in the tanks with equal numbers (21) in each tank. The bottom substrate had now, however, been changed to fine river gravel (<4 mm) in one tank and nothing but the fiber glass gel coat in the other.

The tree groups were weighed again June 17th. At this time the fish in the square tank were transferred to the big brood stock tank again.

The last weighing took place August 18th in all three groups. The remaining numbers were 16 in the big fish group, 20 in the tank with river gravel, and 21 in the tank without substrate.

The fish was hand fed with an ordinary salmon semimoist pellet during the whole experimental period. The fish was fed one meal per day six days per week.

RESULTS

Temperature, salinity

Mean monthly temperatures during the experimental period are given in Figure 1. The salinity was stable at 33.5 o/oo.

Year class separation

Figure 2 gives the weight/length relationship of the 56 fish in the second shipment on arrival. A regression line is fitted.

Individual growth

Figure 3 illustrates individual growth in six fish of the first shipment: two fast growing fish, two slow growers, and two fish with intermediate growth.

Table 1 gives growth parameters of the 12 fish of the first shipment which survived throughout the experimental period.

Substrate preference

Table 2 gives growth parameters for the two groups with and without fine river gravel substrate.

DISCUSSION

Year class separation and growth

Joensen (1954) investigated growth and occurrence of juvenile halibut in Feroe waters. He found that the O-group in July had a total length of ca. 55 mm. This is in good accordance with the results obtained at Austevoll Marine Aquaculture Station in 1985 and 1986.

Joensen (1954) found that I-group fish had a total length of ca. 20 cm, II-group fish were ca. 32 cm, and III-group fish were averaging ca. 45 cm. The IV-group was ranging from 37 cm to 94 cm, but seemed to average around 60 cm.

Figure 1. shows that the fish of shipment two seemed to be divided into four groups. The four smallest fish ranged from 23 to 27 cm in December. This coincides well with Joensen's (1954) I-group average of ca. 20 cm in July. It is also in good accordance with the size of two fry produced at the station in 1985. These fish were the 18th of August 1986 24 and 24,5 cm. It is therefore likely that the four smallest fish were I-group.

The bulk of the shipment (44 fish) grouped around an average length of 35.1 ± 8,7 cm. The range of this group was from 30 cm to 41,5 cm, and it coincides well with Joensen's II-group.

The seven fish of the third segregated group had a length range from 45 cm to 56 cm with an average of 49,4 ± 4,0 cm which fits well with Joensen's III-group.

The remaining halibut of 63 cm was most likely a IV-group fish.

The corresponding medium weights for the presumed I, II, III, and IV-group fish were 187.3 ± 50 g, 655 ± 167 g, 1957 ± 379 g, and 3953 g respectively. If we compare these growth results from nature with i.e. farmed salmon we know that the salmon I-group will be ca. 50 g, the II-group will be ca. 2000 g, and the III-group will

be 5-6000 g. In other words the wild halibut does not grow as well as farmed salmon. If we, however, consider growth in culture, we see that i.e. a small III-group fish (no. 53, table 1) grew from 1700 g in late June - 85 to 5852 g in mid August - 86. Figure 2. gives other evidence to the same effect. This indicates that growth results from nature are not relevant to a culture situation and that much higher growth rates can be obtained under culture conditions.

Still higher growth rates are to be expected after a few generations of effective cultivation due to natural selection (domestication effect) and selective breeding.

Substrate preference

Flatfishes generally have a tendency to burrow, and therefore seem to prefer sandy bottom. From general observations of fish in culture this behaviour seems to be less pronounced in halibut than in for example plaice. After all this is to be expected since it is mainly a deep water fish with limited benefit from visual camouflage.

Almost all the fish in the group without substrate had dark "ventral" sides. This coloration was not observed in the substrate group. Table 2 shows that there was no difference in relative weight gain in the first observation period. In the second period, however, the substrate group grew substatially better than the group without substrate. Whether this result is biologically significant remains to be proven in further experiments.

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Table 1. Growth parameters of twelve juvenile halibut in captivity for fourteen months.

Tag-number	Weight 6/25	Weight 9/12	Growth	Weight 10/15	Growth	Weight 12/12	Growth	Weight 2/18	Growth	Weight 4/15	Growth	Weight 6/16	Growth	Weight 8/18	Growth	Tag-number
51	2800	3400	21.4	3400	0.0	4340	27.6	4890	12.7	5190	6.1	5290	1.9	6690	26.5	51
52	1300	1200	-7.7	1700	41.7	2320	36.5	2740	18.1			3225	17.7	4025	24.8	52
53	1700	2200	29.4	2900	31.8	3590	23.8	4160	15.9	4120	-1.0	4270	3.6	5825	36.4	53
56	3000	3500	16.7	4200	20.0	4950	17.9	5560	12.3	5950	7.0	6115	2.8	8010	31.0	56
57	2500	3700	48.0	4300	16.2	4190	-2.6	4000	-4.5	4170	4.3	4415	5.9	5840	32.3	57
58	1600	1900	18.7	2400	26.3	2610	8.8	2830	8.4			3310	17.0	4730	42.9	58
60	1700	2300	35.3	2700	17.4	2960	9.6	3320	12.2	3490	5.1	3815	9.3	5220	36.8	60
61	1800	2600	44.4	2900	11.5	3390	16.9	3640	7.4	3910	7.4	4100	4.9	5170	26.1	61
62	1600	2100	31.2	2600	23.8	3030	16.5	3330	9.9	3370	1.2	3825	13.5	4950	29.4	62
64	700	1900	171.4	2300	21.1	2610	13.5	3210	23.0	3490	8.7	3910	12.0	4980	27.4	64
65	1800	2200	22.2	2500	13.6	2580	3.2	2560	-0.8			3555	38.9	4330	21.8	65
73	1500	1700	13.3	2100	23.5	2360	12.4	2660	12.7	2920	9.8	3100	6.2	4165	34.4	73
Sum	22000	28700		34000		38930		42900		36610		48930		63935		Sum
Mean	1833	2392	37.0	2833	20.6	3244	15.3	3575	10.6	4068	5.4	4078	11.1	5328	30.8	Mean

Table 2. Growth parameters of the substrate preferance experiment.

	April 15th		June 17th		August 18th	
	Gravel	No gravel	Gravel	No gravel	Gravel	No gravel
N	20	21	20	21	20	21
Mean weight	860 g	1080 g	959 g	1207 g	1142 g	1361 g
SD	171 g	598 g	216 g	594 g	317 g	338 g
Mean length	41.9 cm	43.6 cm	43.5 cm	45.5 cm	47.0 cm	48.9 cm
SD	2.7 cm	7.4 cm	2.9 cm	7.2 cm	3.2 cm	3.4 cm
Weight gain			11.5 %	11.8 %	19.1 %	12.5 %

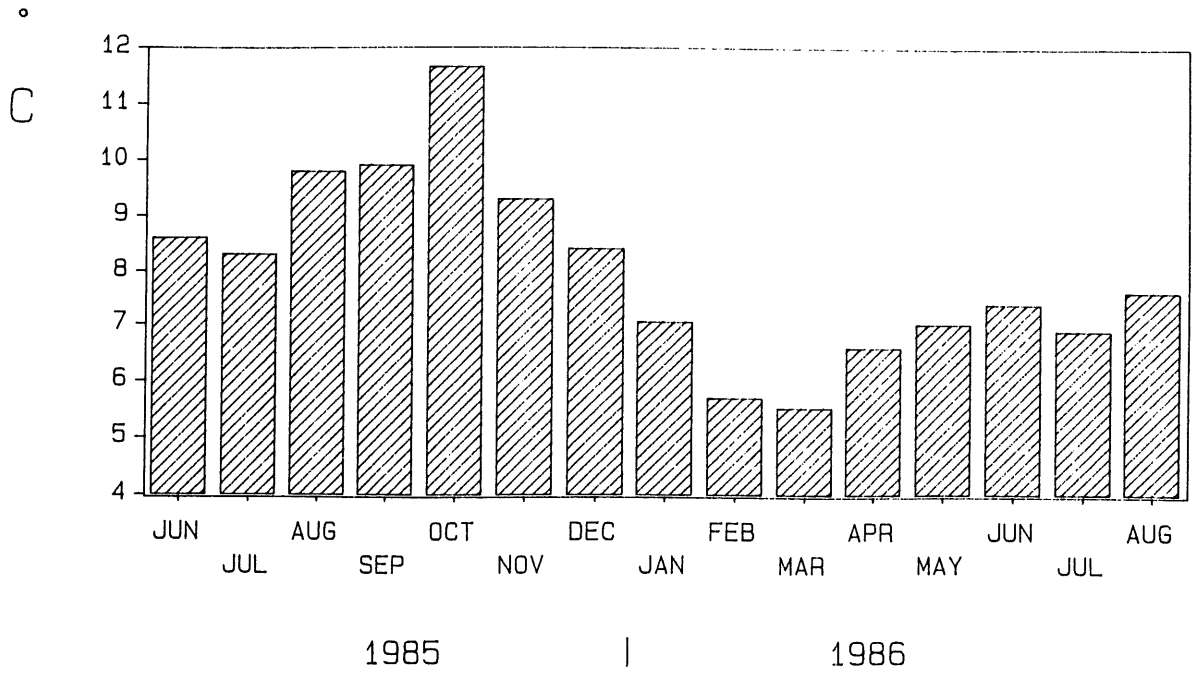

Figure 1. Temperatures during the experimental period.

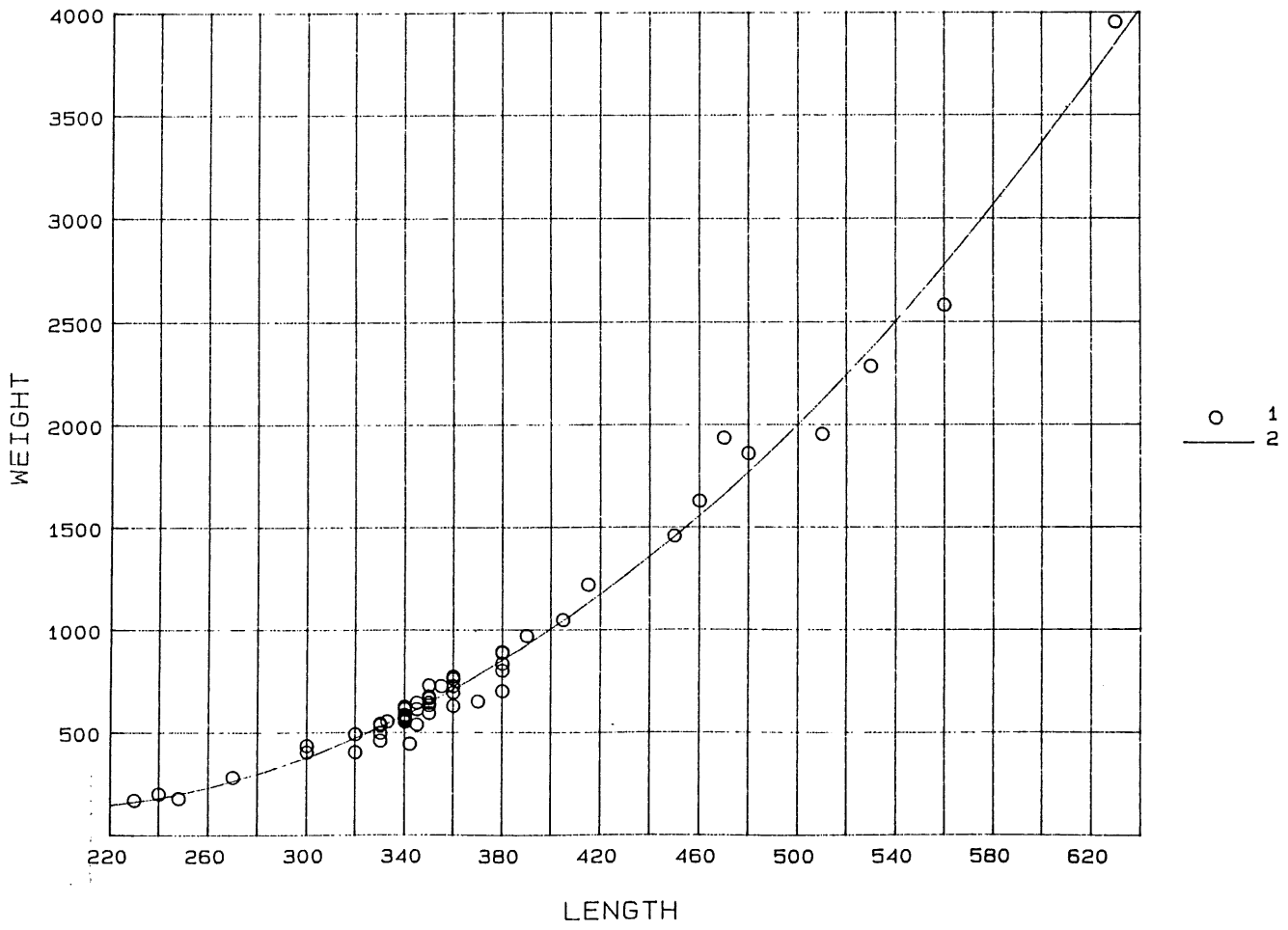

Figure 2. Length weight relationships of 56 juvenile halibut.
1) Individual fish 2) Regression line

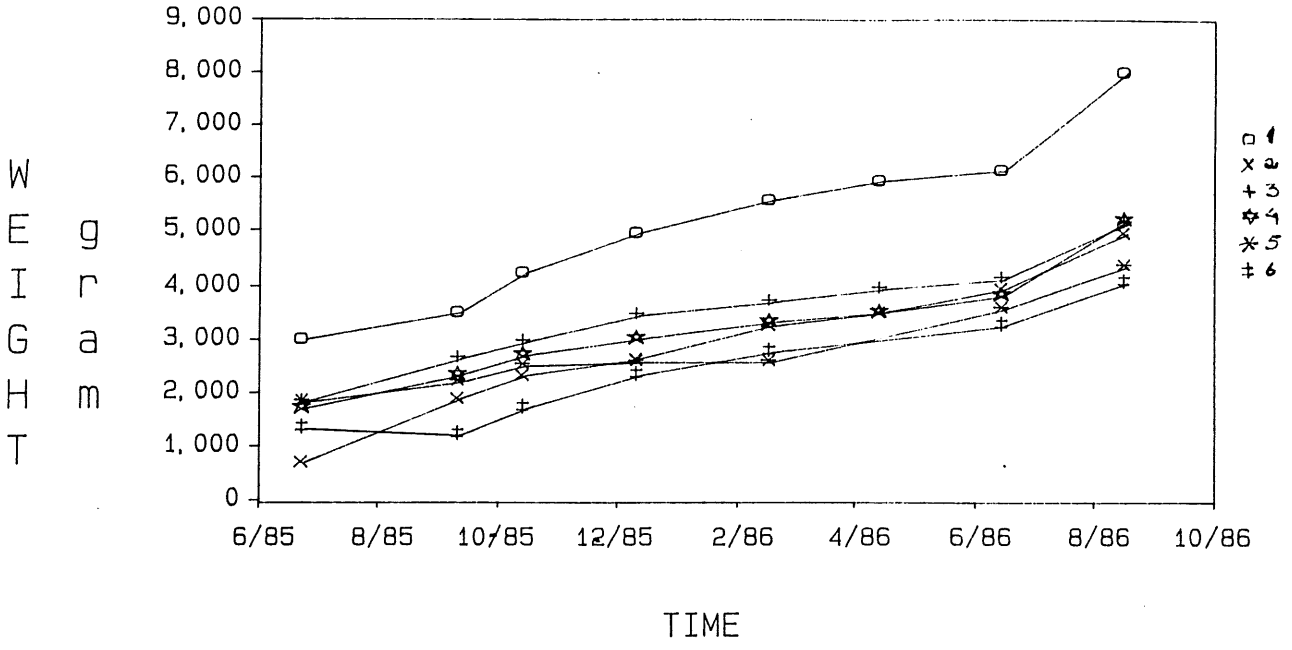

Figure 3. Individual growth patterns in juvenile halibut.
1 and 2) Good growth 3 and 4) Intermediate growth
5 and 6) Inferior growth